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DALMON'S

METRICAL POCKET-BOOK;

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Manual of Weights, Measures and Coins.

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METRICAL POCKET-BOOK;

OR,

MANUAL OF WEIGHTS, MEASURES AND COINS.

METRICAL POCKET-BOOK;

OR,

MANUAL OF WEIGHTS, MEASURES AND COINS.

FOR THE USE OF

MERCHANTS, CLERKS, TRAVELERS, STATISTICIANS, JEWELERS, PHYSICIANS, CHEMISTS, ENGINEERS, MECHANICS, STUDENTS AND TEACHERS;

CONTAINING

THE PRINCIPLES OF THE METRIC SYSTEM; SCALES AND TABLES FOR THE REDUCTION OF ALL THE METRIC, ENGLISH AND UNITED STATES STANDARDS; TABLES OF THE MORE IMPORTANT FOREIGN WEIGHTS, MEASURES AND COINS, WITH THEIR ENGLISH AND METRIC EQUIVALENTS, ETC. ETC.

BY H. DALMON.

PHILADELPHIA
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1870.

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Gift of
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Entered according to Act of Congress, in the year 1869, by

H. DALMON,

In the Clerk's Office of the District Court of the United States for the District of Maryland.

UNIFORM AND UNIVERSAL SYSTEM

OF

WEIGHTS, MEASURES AND COINS.

BY H. DALMON.

Una fides, pondus, mensura, moneta sit una,
Et status illœsus totius orbis erit.

BUDÆUS.

One faith, one weight, one measure and one coin,
Would soon the jarring world in friendship join.

NOTICE.

THE above heading will be the title of a small work, of which the explanations and tables of reduction found herein are only the more practical part.

Besides these, the work alluded to will contain a complete exposition of the metric system as regards both the theory and practice.

Also the division of the circle into 360° of 60′, compared with the decimal division of the same.

A notice of the geographical and nautical measures of different countries.

Explanations of the thermometer and barometer, with formulæ and tables for the reciprocal reduction of the Centigrade and Fahrenheit scales.

Alcoholmetric tables, with directions for the use of the centesimal alcoholmeter in proving the strength of spirituous liquors.

Remarks on and tables of specific gravities, etc., etc.

The whole forming a volume of about three times the extent of this manual.

Every teacher, by a single reading, may find in it a thorough understanding of the metric system, and the pupil a clear and precise exposition of all questions which, in less complete and special treatises, might be found inadequate, or insufficiently explained. For travelers abroad and merchants, especially importers—for physicians, druggists, chemists, engineers, intelligent mechanics, and all those whom commerce or science place in community of ideas with the most enlightened nations—this small work, and more particularly perhaps the part of it we now offer them, will be a most useful pocket-book.

But the metric system, considered without reference to foreign intercourse, and only as an improvement on and a substitute for the weights and measures in present use, would still possess sufficient intrinsic merit to recommend itself to the favor of all intelligent and progressive men of this country.

Now, while it commands the admiration of all the scientific world, and its use has been either adopted or authorized, we believe, by all the nations of Europe and America, it may not be without interest to see how, nearly half a century ago, the celebrated

JOHN QUINCY ADAMS

summed up his view on this system in "his masterly report" to the U. S. Senate of 1821:

". . . Its single standard proportional to the circumference of the earth, the singleness of the units for all the various modes of mensuration, the universal applica-

tion to them of decimal arithmetic, the unbroken chain of connection between all weights, measures, moneys and coins, and the precise, significant, short and complete vocabulary of their denominations, altogether forming a system equally adapted to the use of all mankind, afford such a combination of the principle of uniformity for all the most important intercourse of human society; the establishment of such a system so obviously tends to this great result: the improvement of the physical, moral and intellectual condition of man upon earth, that there can be neither doubt nor hesitation in the opinion that the ultimate adoption and universal application of that system is a consummation devoutly to be wished."

The following quotations from the speech which the

HON. CHARLES SUMNER

delivered on the 27th of July, 1866, before the Senate of the U. S., will be found hardly less explicit:

"Twelve words are all that is required to supply every measure with a peculiar name. . . . A boy at school can master the metric system in an afternoon. Months, if not years, are required to store away the perplexities, incongruities and inconsistencies of the existing weights and measures; and then memory must often fail in reproducing them. The mastery of compound arithmetic is essential in the calculations which they require. All this is done away by the decimal progression, so that the first four rules are ample for the pupil. . . . Thus it becomes labor-saving and time-saving. . . .

"Here is a new element of civilization which will be

felt in all the concerns of life, at home and abroad. It will be hardly less important than the Arabic numerals by which the operations of arithmetic are made common to all nations; . . . it must be taught in schools; our arithmetics must explain it.

"They who have already passed a certain period of life may not adopt it, but the rising generation will embrace it, and ever afterward number it among the choicest possessions of an advanced civilization."

The Congressional Report on the Metric System says: "Your Committee unanimously recommend the passage of the bills and joint resolution appended to this Report. They were not prepared to go, at this time, beyond this stage of progress in the proposed reform. . . . The interests of trade among a people so quick as ours to receive and adopt a useful novelty will soon acquaint practical men with its convenience. When this is obtained—a period, it is hoped, not distant—a further act of Congress can fix the date for its exclusive adoption as a legal system. At an earlier period it may be safely introduced into all public offices and for government service."

Accompanying this Report are the following Bills and Resolutions passed by Congress, July, 1866:

1. A BILL *to authorize the Use of the Metric System of Weights and Measures.*

2. JOINT RESOLUTION *to enable the Secretary of the Treasury to furnish to each State one set of the Standard Weights and Measures of the Metric System.*

3. A BILL *to authorize the Use in Post-offices of Weights of the Denomination of Grams.*

BALTIMORE, August, 1869. H. D.

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METRIC SYSTEM.

FUNDAMENTAL PRINCIPLES.

1. THE metric system is the whole assemblage of measures derived from a fundamental standard, called METER.

All metric measures are uniformly multiplied and divided by *ten*, which causes the system to be also called *decimal system* of weights and measures.

The metric system comprises only five standard units, or six, including the units of moneys.

The names, uses and values of these units are:

1. The METER, standard unit of length and basis of all the other metric measures. It is derived from the dimensions of the earth, forty millions of meters being the length of its circumference around the poles, and ten millions the length of the meridian arc from the equator to either pole.
2. The ARE, unit of land measure, represented by a square surface measuring ten meters on each side.
3. The STERE, unit of solid measure, especially used under this name to measure cord-wood, and equal to *one cubic meter.*

4. The LITER, standard unit of both liquid and dry measure, whose capacity equals *one cubic decimeter.*
5. The GRAM, elementary unit of weight, represented by the weight, *in vacuum*, of *one cubic centimeter* of distilled water at its greatest density.
6. The FRANC, unit of metric money, represented by a silver coin weighing five grams, and of which nine-tenths are fine metal.

2. If to each of these first five names we add successively seven prefixes, we shall have names for metric measures of all kinds and dimensions.

Of the seven required prefixes, four, taken from the Greek, are used to multiply the units by 10, 100, 1 000, 10 000 times their respective values, and thus furnish metric names for the ascending scale.

The four Greek prefixes are:

1. *Deka*, which means TEN.
2. *Hecto*, " " *Hundred.*
3. *Kilo*, " " *Thousand.*
4. *Myria*,* " " *Ten thousand.*

The three remaining prefixes, taken from the Latin, serve to divide the units by 10, 100, 1 000 times their respective values, and thus furnish names for the descending scale.

The three Latin prefixes are:

1. Deci, which means TENTH.
2. Centi, " " Hundredth.
3. Milli, " " Thousandth.

* The denomination of *myria* is now little used, and will hereafter be omitted in the scales and tables of reduction.

Thus the six prefixes in use, set in their natural order, give the following

GENERAL METRIC SCALE.

KILO.	HECTO.	DEKA.	N.	DECI.	CENTI.	MILLI.
					c	*m*
				d	1=	10
				1=	10=	100
		Dk	1=	10=	100=	1 000
	H	1=	10=	100=	1 000=	10 000
K	1 =	10=	100=	1 000=	10 000=	100 000
1 =	10 =	100=	1 000=	10 000=	100 000=	1 000 000

3. Now, if we add to these prefixes the names of the different units, we shall have for each kind of unit a complete series of measures.

Thus, with the meter we have

The Kilometer, or 1 000 meters.
" Hectometer, " 100 "
" Dekameter, " 10 "
" METER, " 1 meter.
" Decimeter, " 0.1 "
" Centimeter, " 0.01 "
" Millimeter, " 0.001 "

A similar series may be obtained with any other unit, such as the *Gram*, the *Liter*, etc.*

Consequently, to express a distance of one thousand meters, or a weight of one thousand grams, we shall use

* Except the unit of money, the *Franc*, which admits no multiplying prefixes. Its divisions are termed *Decime, Centime, Millime,* instead of *Decifranc, Centifranc, Millifranc.* Yet *Decime* and *Millime* are now seldom used.

the words one *Kilometer*, or one *Kilogram*. For a capacity of one hundred, two hundred liters, we shall say one *Hectoliter*, two *Hectoliters;* likewise, two or three hundred ares shall be called two or three *Hectares*, etc.

Reciprocally, the expressions one *Millimeter*, one *Centiare*, one *Decigram* will designate one thousandth of a meter, one hundredth of an are, one tenth of a gram; and two *Dekameters*, five *Hectoliters* will mean the same as 20 meters, 500 liters, etc.

By means of this simple arrangement a complete vocabulary of measures has been made out of twelve words; and each name thus obtained exactly defines the nature and value of the measure to which it can be exclusively applied.*

Practice.

1. Which are the words or prefixes used in the Metric System to express *tens*, *hundreds* and *thousands*, respectively?—Ans. *Deka*, *Hecto*, *Kilo*.

2. Which are those used to express *tenths*, *hundredths* and *thousandths?*—Ans. *Deci*, *Centi*, *Milli*.

3. How many meters in 12 Dekameters?—Ans. 120.

4. How many Kilometers in 36 500 meters?—Ans. 36½.

5. How many Centimeters in 3.4 meters?—Ans. 340.

6. How many ares in 82 Hectares?—Ans. 8200.

7. How many liters to make 18 Hectoliters?

Ans. 1800.

8. How many grams in 26 kilograms?—Ans. 26 000.

9. Which is the single word for hundreds of grams?—Ans. Hectograms.

* For a complete treatise of the metric system, see the work proposed on page v.

IMPORTANT DIRECTIONS

FOR THE

USE OF THE TABLES.

THESE tables show at the same time the equivalents of measures and the comparative prices for any two corresponding units of different systems.

Their use will be illustrated by the actual solution of a few examples:

1st CASE.—Reduction of English measures into metric ones; as, for example, 7 yards in meters. We go to table A, in which we find a column headed *Yards in meters*, and another headed *N*. This column *N* contains the ten first numbers, and stands for the measure first named in the headings of the other columns of this table. Then, for 7 meters, we look in column *N* for the numeral 7, and following the line to column *Yards in meters*, we find the equivalent 6.4 meters, or, more exactly, 6.4008 meters. For 70, 700, 7000 yards, we have the respective equivalents 64.008, 640.08, 6400.8 meters.

Proceeding in the same manner, we find the equivalent of 5 miles to be 8 kilometers 47 meters; that of 40 miles, 64 kilom. 37 dekameters: that of 10 inches, 25 centimeters 4 millimeters, and so on.

To reduce into metric measure such lengths as 125 miles, or 412 feet, we find in the tables that

100	m. =	160.93	Km., and	400	ft. =	121.92	met.
20	" =	32.19	" "	10	" =	3.05	"
5	" =	8.05	" "	2	" =	0.61	"
Hence, 125	m. =	201.17	Km., and	412	ft. =	125.58	met.

2d CASE.—Reduction of metric measures into English ones; as, for instance, 4 meters into yards and into feet.

Using the table A′ as we have done with table A, we find that the column *Meters in yards* gives for 4 meters the equivalent 4.37 yards, or, more exactly, 4.3744 yards; and that the column *Meters in feet* gives for the same length 13.12 feet.

Likewise, 40 and 400 Kilom. equal respectively 24.85, 248.5 miles; and it will be found that 50 and 76 centimeters are respectively equal to 19.69 . . ., 29.92 inches.

3d CASE.—To find the price per metric measure, that for English measure being given.

Ex. 1. A piece of cloth is worth \$3 per yard, what is it worth per meter?

In all questions of price, column N stands for the prices of the measure last named in the headings of the others, whilst the prices of the measures first named are found in the same column as themselves. Thus, for \$3 per yard we point to figure 3 in column N of table A′, and following the line to its intersection with column *Meters in yards*, we find the price per meter corresponding to that of \$3 per yard to be \$3.28.

Ex. 2. What is the price per meter of a piece of cloth which sells at \$2.75 per yard?

In cases similar to this we say:

\$2.00	per	yard	are	\$2.1872	per meter.
\$0.70	"	"	"	\$0.7655	" "
\$0.05	"	"	"	\$0.0546	" "

Hence, cloth at \$2.75 per yard is at \$3.0073 per meter.

4th CASE.—To find the price per English measure, the price per metric measure being known.

Ex. 1. What is the price per yard of a piece of cloth which costs 20 francs per meter?

Table A gives, at the intersection of its 2d line with the column *Yards in meters*, fr. 1.82 . . . as the price per yard corresponding to that of 2 fr. per meter, or fr. 18.28, as the price per yard corresponding to 20 fr. per meter.

Remark 1. The relative price per yard might also be obtained by multiplying the price per meter by the equivalent of one yard in meters. Thus, 24.85 fr. per meter $\times$ 0.9144 gives fr. 22.72 per yard.

In like manner, a number of meters, multiplied by the equivalent of 1 meter in yards, will give the equivalent length in yards.

Remark 2. A fractional quantity may be translated from one system into the other by multiplying it by the equivalents of its unit. Thus, $1\frac{1}{2}$ inch $\times$ 2.54 (equivalent of 1 inch in centimeters) = 3.81 centimeters, or 38.1 millimet.; and $\frac{2}{3}$ gallon $\times$ 3.78 (equiv. of 1 gal. in liters) = 2.52 liters. . . .

APPROXIMATION OF THE TABLES.

All through these tables the exact value of measures is approximated within half a unit of the order of the last figure. Thus, 1.609 kilometers, or 1609 meters, given for the equivalent of 1 mile, cannot differ more than by half a meter from the exact length of 1 mile. The same remark holds good for the equivalents of 2, 3, 4 . . . miles, and of 2, 3, 4 . . . units of all the measures translated in these tables.

It will be seen that the equivalents of 10 generally extend to a greater number of decimals than those of

the nine simple digits. This will afford the means of converting measures with greater accuracy when the approximation given in the body of the tables shall not be deemed sufficient.

Thus, to know the value of 1 mile in metric measures with all the accuracy afforded by the tables, we have (table A) 10 miles = 16.0935 kilom. Hence, 1.60935 kilom. is the length of 1 mile within half a centimeter; and therefore 1.60935 kilom. × any number of miles, will give the equivalent of that number of miles within half a centimeter per mile.

SUBSTITUTION OF ONE METRIC DENOMINATION FOR ANOTHER.

In consequence of the metric measures being decimal, every English unit may be converted into any metric denomination of its kind, by merely changing the place of the decimal point in the metric equivalent. Thus,

1 yard { =0.9144 meters, = 9.144 decim. = 91.44 centim. = 914.4 millim.

3 bushels { =1.057 Hectolit. =10.57 dekalit. =105.7 liters, = 1057 decilit.

Reciprocally, all the metric denominations of the same kind can be translated into any single English unit of that kind by the same process. Thus,

1 meter, =1.0936
1 dekam. =10.936
1 hectom. =109.36
1 kilom. =1093.6
} yards.

2 liters, =0.528
2 dekal. =5.283
2 hectol. =52.83
2 kilolit. =528.3
} W. galls.

CONTRACTION IN THE MULTIPLICATION AND DIVISION OF DECIMALS.

As the conversion of measures may give frequent occasion for multiplications and divisions of numbers con-

taining more decimals than necessary for the degree of approximation required in the result, we propose for such cases the following contracted methods:

CONTRACTED MULTIPLICATION.—RULE.*— *Write the unit's place of the multiplier under that figure of the mulplicand whose place is the last to be retained in the product, and dispose of all the other figures of the multiplier in an order contrary to the usual one. Then, in multiplying, begin for each partial product with that figure of the multiplicand which stands above the multiplying figure, observing to add to the product the number nearest to that which would have been carried if the places of the right had not been rejected. Write down the several partial products, so that the right-hand figure of each shall be in the same vertical column. This sum will be the product required.*

Ex. Reduce 106.225 meters into feet with the approximation of 0.1 foot.

Contracted method.	Ordinary method.
106.225	106.225
8082.3	3.2808
3187=product by 3+1.	849800
212=product by 2	84 9800
85=product by 8+5	212 450
1=nearest number	3186 75
348.5 ft.=product required.	348.5 029800

CONTRACTED DIVISION.—RULE.—*First consider how many figures in all it is necessary for the quotient to contain. Then, by using the same number of figures from*

* The text of this and the next rule belongs to B. Greenleaf's National Arithmetic.

the left of the divisor, find the first figure of the quotient, and, instead of bringing down a new figure from the dividend, or annexing a cipher to the remainder, reject a figure on the right of the divisor at each successive division, and make the other figures a divisor. In multiplying such a divisor by the quotient figure, observe to add to the product the number nearest to that which would have been carried if no figures had been rejected.

Ex. Divide 34.850298 by 3.2808, so as to have correct figures for the two places on the right of the decimal point.

Contracted method.

Dividend.	Divisor.
34.85 0 2 9 8	3.280 8
3281=3280×1+1	10.62 quotient.
204	
197=3.2×6+5	
7	
7=3×2+1	
0	

Ordinary method.

34.85	0298	3.2808
3280	8	10.62
204	229	
196	848	
7	3818	
6	5616	
0	8202	

MEASURES OF LENGTHS.

English Scale.

Mile.	Furlongs.	Rods.	Yards.	Feet.	Inches.	Lines.
					in.	*ln.*
				ft.	1 =	12
			yd.	1 =	12 =	144
		rd.	1 =	3 =	36 =	432
	fur.	1 =	5½ =	16½ =	198	
m.	1 =	40 =	220 =	660 =	7920	
1 =	8 =	320 =	1760 =	5280 =	63360	

Other Measures.—A hand equals 4 inches; 1 fathom, 6 feet; 1 knot, or geographical mile, is $\frac{1}{60}$ of a degree of the circumference of the earth; 3 knots make a marine league = $\frac{1}{20}$ degree.

In surveyor's measure, $\frac{1}{10}$ of a furlong equals 1 chain = 4 poles = 100 links = 66 feet = 20.117 meters; 1 pole = 25 links, or 16½ feet.

Metric Scale.

Kilom.	Hectom.	Dekam.	Meter.	Decimet.	Centimeters.	Millimeters.
					cm.	*mm.*
				dm.	1 =	10
			met.	1 =	10 =	100
		Dkm.	1 =	10 =	100 =	1 000
	Hm.	1 =	10 =	100 =	1 000 =	10 000
Km.	1 =	10 =	100 =	1 000 =	10 000 =	100 000
1 =	10 =	100 =	1 000 =	10 000 =	100 000 =	1 000 000

Note.—The value of the meter has been found very nearly equal to 39.37 English inches: and our tables for the conversion of Lengths, Squares and Cubes are calculated upon this [illegible] basis.

TABLES A, A′.—*English measures of* LENGTH *reduced into metric ones, and reciprocally.*

A.

N	Miles in Kilometers.	Rods in Meters.	Yards in Meters.	Feet in Meters.	Inches in Centim.	Lines in Millim.
1	1.609	5.03	0.9144	0.3048	2.54	2.12
2	3.219	10.06	1.8288	0.6096	5.08	4.23
3	4.828	15.09	2.7432	0.9144	7.62	6.35
4	6.437	20.12	3.6576	1.2192	10.16	8.47
5	8.047	25.15	4.5720	1.5240	12.70	10.58
6	9.656	30.18	5.4864	1.8288	15.24	12.70
7	11.265	35.20	6.4008	2.1336	17.78	14.82
8	12.875	40.23	7.3152	2.4384	20.32	16.93
9	14.484	45.26	8.2296	2.7432	22.86	19.05
10	16.0935	50.29	9.1440	3.0480	25.40	21.17
Price per met.meas.	Price per mile.	Price per rod.	Price per yard.	Price per foot.	Price per inch.	Price per line.

A′.

N	Kilomet. in Miles.	Dekam. in Rods.	Meters in Yards.	Meters in Feet.	Centim. in Inches.	Millim. in Lines.
1	0.621	1.988	1.0936	3.281	0.394	0.47
2	1.243	3.977	2.1872	6.562	0.787	0.94
3	1.864	5.965	3.2808	9.842	1.181	1.42
4	2.485	7.953	4.3744	13.123	1.575	1.89
5	3.107	9.942	5.4681	16.404	1.969	2.36
6	3.728	11.930	6.5617	19.685	2.362	2.83
7	4.350	13.919	7.6553	22.966	2.756	3.31
8	4.971	15.907	8.7489	26.246	3.150	3.78
9	5.592	17.895	9.8425	29.527	3.543	4.25
10	6.2137	19.884	10.9361	32.808	3.937	4.72
Price per Eng.meas	Price per kilom.	Price per dekam.	Price per meter.	Price per meter.	Price per centim.	Price per millim

MEASURES OF SURFACES.

English Scale.

Square Mile.	Acres.	Roods.	Sq. Rods.	Sq. Yards.	Sq. Feet.	Sq. Inches.
					ft.	*in.*
				yds.	1 =	144
			p.	1 =	9 =	1 596
		R.	1=	30¼=	272¼	
	A.=	1=	40=	1 210 =	10 890	
S.M.	1=	4=	160=	4 840 =	43 560	
1=640=	2 560=	102 400=	3 097 600			

Surveyor's Measure.

Acre.	Sq. Chains.		Sq. Poles.		Sq. Links.		Sq. Feet.
			1	=	625	=	272¼
	1	=	16	=	10 000	=	4 356
1	= 10	=	160	=	100 000	=	43 560

Note.—A section of government land is 1 square mile. An acre, as a square surface, will measure on each side 63.615 meters.

Metric Scale.

Sq. Km.	Sq. Hm. or Hectares.	Sq. Dkm. or Ares.	Sq. Meters or Centiares.	Sq. dm.	Sq. cm.
				dm².	*cm².*
			ca. or *m².*	1 =	100
		a.	1 =	100 =	10 000
	Ha.	1 =	100		
Km².	1 =	100 =	10 000		
1 =	100 =	10 000 =	1 000 000		

TABLES B, B′.—*English* SQUARE MEASURES *reduced into metric ones, and reciprocally.*

B.

N	Sq. Miles in Sq.Kilom.	Acres in Hectares.	Rods in Centiares.	Sq Yds. in Sq.Met.	Sq. Feet in Sq. dm.	Sq Inch. in Sq. cm.
1	2.59	0.4047	25.29	0.8361	9.29	6.45
2	5.18	0.8094	50.59	1.6723	18.58	12.90
3	7.77	1.2141	75.88	2.5084	27.87	19.35
4	10.36	1.6187	101.17	3.3445	37.16	25.81
5	12.95	2.0234	126.46	4.1806	46.45	32.26
6	15.54	2.4281	151.76	5.0168	55.74	38.71
7	18.13	2.8328	177.05	5.8529	65.03	45.16
8	20.72	3.2375	202.34	6.6890	74.32	51.61
9	23.31	3.6422	227.64	7.5252	83.61	58.07
10	25.90	4.04687	252.93	8.3613	92.903	64.52
Price per met. meas.	Price per sq. mile.	Price per acre.	Price per sq. rod.	Price per sq. yard.	Price per sq. foot.	Price per sq. inch.

B′.

N	Sq.Kilom. in Sq. Miles.	Hectares in Acres.	Ares in Sq. Rods.	Sq. Met. in Sq. Yds.	Sq. Met. in Sq. Feet.	Sq. cm. in Sq. Inch.
1	0.3861	2.471	3.954	1.196	10.76	0.155
2	0.7722	4.942	7.907	2.392	21.53	0.310
3	1.1583	7.413	11.861	3.588	32.29	0.465
4	1.5444	9.884	15.814	4.784	43.05	0.620
5	1.9305	12.355	19.768	5.980	53.82	0.775
6	2.3166	14.826	23.721	7.176	64.58	0.930
7	2.7027	17.297	27.675	8.372	75.35	1.085
8	3.0888	19.768	31.628	9.568	86.11	1.240
9	3.4749	22.239	35.582	10.764	96.87	1.395
10	3.8610	24.710	39.536	11.960	107.64	1.550
Price per Eng. meas	Price per sq. kilom.	Price per hectare.	Price per are.	Price per sq. met.	Price per sq. meter.	Price per sq. centim.

SOLID OR CUBIC MEASURE.

English Measures.

Cord.		Tons.		Cub. Yards.		Cub. Feet.		Cub. Inches.
						1	=	1 728
		T.		1	=	27	=	46 656
C.		1	=	$1\frac{13}{27}$	=	40	=	69 120
1	=	$3\frac{1}{5}$	=	$4\frac{20}{27}$	=	128	=	221 184

Metric Measures.

Cubic Meter.		Cub. Decimeters.		Cub. Centimeters.
		dm^3.		cm^3.
m^3.		1	=	1 000
1	=	1 000	=	1 000 000

Note.—The cubic meter, as a unit of measure for cord-wood, is called *Stere;* whilst, as a unit of measure to express the capacity of ships and vessels, the French generally call it *Tonneau,* instead of *Kiloliter,* which would be in this case the proper systematical word.

The word *Tonneau* is also used in French shipping to express the weight of one cubic meter of water—that is, 1000 kilograms; but, for all overland transportations and estimations, 1000 kilograms are called *Tonne.*

These names belonged to the old French nomenclature, but their application to the new units may cause confusion, and constitutes irregularities which ought not to be admitted outside the French nation. Therefore, when meaning capacity, the term *Tonneau* will be replaced in these tables by *Kiloliter,* which defines itself; and 1000 kilograms will be in all cases called *Tonne,* or *metric ton.*

TABLES C, C′.—*English* CUBIC MEASURES *reduced into metric ones, and reciprocally.*

C.

N	Cub. Yards in Cub. Meters.	Cub. Feet in Cub. Decim.	Cub. Inches in Cubic Centimeters	Tons of 40 Cub. Feet in Kiloliters.	Cords in Steres.
1	0.7646	28.317	16.387	1.133	3.625
2	1.5291	56.634	32.774	2.265	7.249
3	2.2937	84.951	49.161	3.398	10.874
4	3.0582	113.268	65.549	4.531	14.498
5	3.8228	141.585	81.936	5.663	18.123
6	4.5874	169.902	98.323	6.796	21.747
7	5.3518	198.219	114.710	7.929	25.372
8	6.1165	226.536	131.097	9.061	28.997
9	6.8810	254.853	147.484	10.194	32.621
10	7.64559	283.170	163.8716	11.3268	36.246
Price per met. meas.	Price per cub. yard.	Price per cub. foot.	Price per cub. inch.	Price per ton.	Price per cord.

C′.

N	Cub. Meters in Cub. Yards.	Cub. Meters in Cub. Feet.	Cub. Decim. in Cub. Inches.	Kiloliters in 40 Cub. Feet Tons.	Steres in Cords.
1	1.308	35.314	61	0.883	0.276
2	2.616	70.629	122	1.766	0.552
3	3.924	105.943	183	2.649	0.828
4	5.232	141.258	244	3.531	1.104
5	6.540	176.572	305	4.414	1.379
6	7.848	211.887	366	5.297	1.655
7	9.156	247.201	427	6.180	1.931
8	10.464	282.516	488	7.063	2.207
9	11.772	317.830	549	7.946	2.483
10	13.0794	353.1445	610.234	8.8286	2.7589
Price per Eng. meas.	Price per cub. meter.	Price per cub. meter.	Price per cub. decimet.	Price per kiloliter.	Price per stere.

MEASURES OF CAPACITY.

U. S. Dry Measure.

Bushel.		Pecks.		Gallons.		Quarts.		Pints.
				gal.		*qt.*		*pt.*
		pk.		1	=	4	=	8
bu.		1	=	2	=	8	=	16
1	=	4	=	8	=	32	=	64

U. S. Liquid Measure.

Gallons.		Quarts.		Pints.		Gills.
		qt.		*pt.*		*gi.*
gal.		1	=	2	=	8
1	=	4	=	8	=	32

The *Tun* = 2 *Pipes* = 4 *Hogsheads* = 252 Gallons = 953.9 liters.

The *barrel* contains from 28 to 32 gallons.

Note.—The capacity of the U. S. bushel = 2150.42 cubic inches; and that of the U. S. liquid gallon = 231 cubic inches. Therefore, these numbers, multiplied by 16.38716 (equivalent of one cubic inch in cubic centimeters), give for the value of the bushel, 2150.42×16.38716 = 35239 cubic centimeters, or 35.239 liters: and for the value of the liquid, or wine gallon, 231×16.38716=3785.43 cubic centimeters, or 3.7854 . . . liters.

Metric Dry and Liquid Measure.

Kilolit.		Hectolit.		Dekalit.		Liters.		Deciliters.		Centiliters.
								dl.		*cl.*
						l.		1	=	10
				dkl.		1	=	10	=	100
		hl.		1	=	10	=	100	=	1 000
kl.		1	=	10	=	100	=	1 000	=	10 000
1	=	10	=	100	=	1 000	=	10 000	=	100 000

TABLES D, D′.—*U. S. measures of* CAPACITY *reduced into metric ones, and reciprocally.*

D.

	Dry Measure.			Liquid Measure.	
N	Bushels in Hectoliters.	Pecks in Dekaliters.	Quarts in Liters.	Gallons in Liters.	Quarts in Liters.
1	0.3524	0.88	1.10	3.785	0.95
2	0.7048	1.76	2.20	7.571	1.89
3	1.0572	2.64	3.30	11.356	2.84
4	1.4096	3.52	4.40	15.142	3.79
5	1.7620	4.40	5.51	18.927	4.73
6	2.1144	5.29	6.61	22.713	5.68
7	2.4668	6.17	7.71	26.498	6.62
8	2.8191	7.05	8.81	30.283	7.57
9	3.1715	7.93	9.91	34.069	8.51
10	3.52393	8.810	11.01	37.8543	9.464
Price per met. meas.	Price per bushel.	Price per peck.	Price per quart.	Price per gallon.	Price per quart.

D′.

N	Hectoliters in Bushels.	Dekaliters in Pecks.	Liters in Quarts.	Hectoliters in Gallons.	Liters in Quarts.
1	2.838	1.135	0.91	26.417	1.06
2	5.675	2.27	1.82	52.834	2.11
3	8.513	3.41	2.72	79.251	3.17
4	11.351	4.54	3.63	105.668	4.23
5	14.189	5.68	4.54	132.085	5.28
6	17.026	6.81	5.45	158.502	6.34
7	19.864	7.95	6.36	184.919	7.39
8	22.702	9.08	7.26	211.336	8.45
9	25.540	10.22	8.17	237.753	9.51
10	28.3774	11.351	9.081	264.170	10.57
Price per Eng. meas.	Price per hectoliter.	Price per dekaliter.	Price per liter.	Price per hectoliter.	Price per liter.

AVOIRDUPOIS WEIGHT.

Pounds.		Ounces.		Drams.		Equivalent in tr. grains.
				dr.		
		oz.		1	=	$27\frac{11}{32}$
lb.		1	=	16	=	$437\frac{1}{2}$
1	=	16	=	256	=	7 000

100 lb. = 4 quarters = 1 hundredweight; 2000 lb. = 1 ton. In England, as in the U. S. Custom Houses, the ton = 2240 lb.

METRIC WEIGHTS.

Ton.* (metric.)		Quintals. (metric.)		Kilograms.		Hectog.		Dekag.		Grams.
								dkg.		*g.*
						hg.		1	=	10
				kg.		1	=	10	=	100
		qm.		1	=	10	=	100	=	1 000
tm.		1	=	100						
1	=	10	=	1 000						

The *kilogram* is the commercial unit.

Equation between Metric and English Weights.

The value attributed to the kilogram varies among experimenters from 2.2045 to 2.2060 lb. avoirdupois.

The following tables are based upon the equation

$$1 \text{ kilogram} \begin{cases} = 2.20462 \text{ lb. avoird.} \\ = 15432.35 \text{ Troy grains.} \end{cases}$$

These numbers result from the experiments of Prof. Miller, related in the Philosophical Transactions of 1856.

From Mr. Miller's detailed report, it seems probable that such an operation has never been conducted with so much minute attention, nor in more favorable circumstances to produce a correct and accurate result.

* See page 26, NOTE.

TABLES E, E′, AVOIRDUPOIS WEIGHT *reduced into metric weight, and reciprocally.*

E.

N	C. H. Tons (2240 lb.) in Metric Tons.	Short Tons (2000 lb.) in Metric Tons.	Pounds in Kilograms.	Ounces in Grams.	Drams in Grams.
1	1.016	0.907	0.4536	28.35	1.77
2	2.032	1.814	0.907	56.70	3.54
3	3.048	2.722	1.361	85.05	5.32
4	4.064	3.629	1.814	113.40	7.09
5	5.080	4.536	2.268	141.75	8.86
6	6.096	5.443	2.722	170.10	10.63
7	7.112	6.350	3.175	198.45	12.40
8	8.128	7.258	3.629	226.80	14.17
9	9.144	8.165	4.082	255.15	15.95
10	10.1605	9.0719	4.5359	283.50	17.72
Price per m. weight.	Price per C. H ton.	Price per 2000 lb. tons.	Price per pound.	Price per ounce.	Price per dram. av.

E′.

N	Metric Tons in C. H. Tons.	Metric Tons in 2000 lb. tons.	Kilograms in Pounds.	Kilograms in Ounces.	Grams in Drams.
1	0.984	1.102	2.205	35.27	0.56
2	1.968	2.205	4.409	70.55	1.13
3	2.953	3.307	6.614	105.82	1.69
4	3.937	4.409	8.818	141.10	2.26
5	4.921	5.512	11.023	176.37	2.82
6	5.905	6.614	13.228	211.64	3.39
7	6.889	7.716	15.432	246.92	3.95
8	7.874	8.818	17.637	282.19	4.52
9	8.858	9.921	19.842	317.46	5.08
10	9.8420	11.0231	22.0462	352.74	5.644
Price per Eng. wt.	Price per metric ton.	Price per metric ton.	Price per kilogram.	Price per kilogram.	Price per gram.

TABLE F.— *Weight in Kilograms and Pounds of one Hectoliter and of one Bushel of various commodities.**

	Hectoliter		Bushel	
	in Kilog.	in Pounds.	in Pounds.	in Kilog.
Flour, compressed.....	106	222	82	37.2
Wheat, very fine.....	80	176	62	28.2
" fine.....	77	170	60	27.2
Rye, average.....	72	159	56	25.5
Barley "	62	136	48	22
Corn, "	72	160	56	25.5
Oats, "	41	91	32	14.5
Buckwheat, average...	65	143	50	23
Rice, decorticated	61	135	47.4	21.5
" in the hull.....	75	165	58	26.3
Beans, average.....	77	170	60	27.2
Horse-beans, average..	88	194	68.5	31
Lentils, " ..	85	187	66	30
Peas, " ..	79	175	62	28
Cloverseed, " ..	77	170	60	27.2
Flaxseed, " ..	72	159	56	25.4
Rapeseed, " ..	68	150	53	24
Potatoes, " ..	64	141	50	23
Bran, " ..	26	57	20	9

NOTES.—1. The weight of one *Hectoliter* in *kg.* × 0.777 gives the weight of one *Bushel* in pounds; and the weight of one *Bushel* in pounds × 1.287 gives the weight of one *Hectoliter* in *kg.*

2. Of fine wheat 100 *kg.* gives 80 *kg.* of pure white flour 14 *kg.* half white, and 24 *kg.* of bran of all grades: 2 *kg.* are lost. Of flour, 100 *kg.* will give 140 *kg.* of bread.

* The weight of most of the articles of this table may vary from the average so far as 3 or 4 per cent., according to quality.

In French markets flour is often sold by the sack of one and a half hectoliters, weighing 159 kilog., or 351 pounds av. The English sack of flour weighs 275 lb., or 125 kilog. The U. S. barrel of flour weighs 196 pounds, or 89 kg.

TABLE G.—*Miscellanea.*

1 Stone of Iron or Lead weighs	14 lb.,	or	6.35	kg.
1 Pig = 21½ stones,	301 "	"	137	"
1 Fother = 8 pigs,	2408 "	"	1092	"
1 Keg of powder,	25 "	"	11.34	"
1 Firkin of butter,	56 "	"	25.4	"
1 Quintal of Fish,	100 "	"	45.4	"
1 Barrel of Beef or Pork,	200 "	"	90.7	"
1 Barrel of Soap,	256 "	"	116.1	"

TABLE H.— *Weight in Kilograms and Pounds of one Liter and of one Gallon of various liquids.*

Names of the liquids weighed in air at 15° Centigrade.	Weight of 1 Liter in Grams.	Weight of 1 Liter in Pounds.	Weight of 1 Gallon in Pounds.	Weight of 1 Gallon in Kilog.
Alcohol, pure.	800	1.76	6.68	3.03
Proof spirits *.....	922	2.03	7.69	3.49
Camphene	869	1.92	7.25	3.29
Sperm oil	924	2.04	7.70	3.50
Olive oil.....	917	2.02	7.65	3.45
Linseed oil	935	2.10	7.80	3.54
Petroleum	840	1.85	7.01	3.22
Molasses.....	1390	3.06	11.64	5.28
Water, at 4° C.	998.6	2.202	8.334	3.78

Note.—The weight of one Liter in kg. × 8.345, gives the weight of one *Gallon* in pounds; and the weight of one *Gallon* in pounds × 0.11956, gives the weight of one *Liter* in kg.

* Proof spirits contain 56 per cent. of pure alcohol and 44 per cent. of water by volume.

TROY AND APOTHECARIES' WEIGHT.

Pounds.		Ounces.		Drams.		Scruples.		Pennyweights.		Grains.
								pw.		*gr.*
						sc.		1	=	24
				dr.		1	=	$\frac{4}{5}$	=	20
		oz.		1	=	3	=	$2\frac{1}{2}$	=	60
lb.		1	=	8	=	24	=	20	=	480
1	=	12	=	96	=	288	=	240	=	5 760

NOTE.—In this scale the dram and scruple belong only to apothecaries' weight; the pennyweight belongs only to Troy weight, and the pound, ounce and grain are common to both. Troy weight is used only for gems and precious metals.

METRIC WEIGHTS.

GRAM.		Decigrams.		Centigrams.		Milligrams.
				cg.		*mg.*
		dg.		1	=	10
g.		1	=	10	=	100
1	=	10	=	100	=	1 000

This scale is simply an extension of that of page 30, as there is only one metric weight. Therefore units above the gram may be seen on said page.

DIAMOND WEIGHT.—The *Carat*, unit of weight for diamonds and other fine stones, is equivalent to 205 milligrams, so that 1 gram equals 4 878 carats.

Small diamonds are sold in lots before being cut, for about $10 per carat. The value of a rough diamond, weighing from 1 to 8 or 10 carats, may be approximately obtained by multiplying by 10 the square of its weight in carats; and that of a cut diamond, by multiplying by 10 the square of twice its weight in carats.

Diamonds above these sizes are very rare, and their value increases still more rapidly. Thus, the *Regent* of the crown of France, a diamond of 136 carats, is estimated at more than five millions of francs.

TABLES K, K′. — TROY *and* APOTHECARIES' WEIGHT, *reduced into metric weight, and reciprocally.*

K.

N	Pounds in Kilog.	Ounces in Grams.	Ap. dr. in Grams.	Ap. sc. in Grams.	Tr. pwt. in Grams.	Tr. grains in Centig.
1	0.3732	31.10	3.89	1.30	1.555	6.48
2	0.746	62.21	7.78	2.59	3.110	12.96
3	1.120	93.31	11.66	3.89	4.666	19.44
4	1.493	124.41	15.55	5.18	6.221	25.92
5	1.866	155.52	19.44	6.48	7.776	32.40
6	2.239	186.62	23.33	7.78	9.331	38.88
7	2.613	217.72	27.22	9.07	10.886	45.36
8	2.986	248.83	31.10	10.37	12.441	51.84
9	3.359	279.93	34.99	11.66	13.997	58.32
10	3.7324	311.035	38.88	12.96	15.552	64.799
Price per met. wt.	Price per pound.	Price per ounce.	Price per ap. dram.	Price per scruple.	Price per pennywt.	Price per tr. grain.

K′

N	Kilograms in Pounds.	Kilograms in Ounces.	Grams in Ap. dr.	Grams in Ap. sc.	Grams in Tr. pwt.	Grams in Tr. gr.
1	2.679	32.151	0.26	0.77	0.643	15.432
2	5.358	64.302	0.51	1.54	1.286	30.865
3	8.038	96.452	0.77	2.31	1.929	46.297
4	10.717	128.603	1.03	3.09	2.572	61.729
5	13.396	160.754	1.29	3.86	3.215	77.162
6	16.075	192.905	1.54	4.63	3.858	92.594
7	18.755	225.055	1.80	5.40	4.501	108.026
8	21.434	257.206	2.06	6.17	5.144	123.459
9	24.113	289.357	2.31	6.94	5.787	138.891
10	26.792	321.508	2.57	7.72	6.430	154.323
Price per Eng. wt.	Price per kilogram.	Price per kilogram.	Price per gram.	Price per gram.	Price per gram.	Price per gram.

ASSAY CARAT AND MILLIÈMES.

The term *carat* is also used to indicate the fineness of precious metals. Every ingot of gold or silver is supposed to consist of 24 parts of equal weight, and those parts which are of fine metal are called *carats*. Thus, pure gold is called 24-carât gold; and an alloy of 20 parts pure gold with 4 parts of another metal is called 20-carat gold.

In France and other countries the fineness of metals is now expressed in *millièmes* or thousandths. Thus, pure or 24-carat gold is termed gold at 1000 millièmes. Hence, gold at 18 carats, or three-fourths fine, is labeled $\frac{750}{1000}$, or $\frac{75}{100}$ gold. This estimation of fineness in millièmes being decimal, is more convenient for calculations, and ought to be everywhere preferred.

For the value of gold at these different degrees of fineness, and the reciprocal translation of assay carats and millièmes, see tables Q and R, pages 43 and 44.

APOTHECARIES' MEASURES.

Gallon.		Pints.		Gills.		Fluid oz.		Fluid dr.		Minims.
								ƒʒ.		m.
						ƒʒ.		1	=	60
				G.		1	=	8	=	480
		P.		1		4	=	32		
Cong.		1	=	4	=	16	=	128		
1	=	8	=	32	=	128				

The gallon, in apothecaries' measure, is the same as the wine gallon. Sixteen minims, or drops of water, give about the weight of 1 gram, and the volume of 1 cubic centimeter, or milliliter.

TABLES L, L′.—APOTHECARIES' MEASURES, *reduced into metric ones, and reciprocally.*

L.

N	Pints in Liters.	Gills in Deciliters.	Fluid oz. in Centiliters.	Fluid dr. in Centiliters.	Minims in Milliliters.
1	0.47	1.18	3.0	0.37	0.06
2	0.95	2.37	5.9	0.74	.12
3	1.42	3.55	8.9	1.11	.19
4	1.89	4.73	11.8	1.48	.35
5	2.37	5.91	14.8	1.85	.31
6	2.84	7.10	17.8	2.22	.37
7	3.31	8.28	20.7	2.59	.44
8	3.79	9.46	23.7	2.96	.49
9	4.26	10.65	26.6	3.33	.55
10	4.73	11.83	29.6	3.70	.616
Price per met. meas.	Price per pint.	Price per gill.	Price per fluid oz.	Price per fluid dr.	Price per minim.

L′.

N	Liters in Pints.	Deciliters in Gills.	Centiliters in Fluid oz.	Centiliters in Fluid dr.	Milliliters in Minims.
1	2.11	0.85	0.34	2.7	16
2	4.23	1.69	0.68	5.4	32
3	6.34	2.54	1.01	8.1	49
4	8.45	3.38	1.35	10.8	65
5	10.57	4.23	1.69	13.5	81
6	12.68	5.07	2.03	16.2	97
7	14.79	5.92	2.37	18.9	114
8	16.90	6.76	2.71	21.6	130
9	19.02	7.61	3.04	24.3	146
10	21.13	8.454	3.38	27.05	162
Price per Eng. meas.	Price per liter.	Price per deciliter.	Price per centiliter.	Price per centiliter.	Price per milliliter.

BRITISH MEASURES OF CAPACITY.

The *Imperial* measures of capacity adopted in Great Britain serve both for dry and liquid measures, and are all derived from the Gallon, according to the same scale as the U. S. measures.

The *Imperial Gallon* contains 277.274 cubic inches, which makes five Imperial measures very nearly equal to six U. S. wine measures of the same denomination, or 32 Imp. measures, about 33 U. S. dry measures.

IMPERIAL DRY AND LIQUID MEASURE.

Sacks.		Bushels.		Pecks.		Gallons.		Quarts.		Pints.
						1	=	4	=	8
				1	=	2	=	8	=	16
		1	=	4	=	8	=	32	=	64
1	=	3	=	12	=	24	=	96	=	192

1 Pint = 20 fluidounces = 160 f℥ = 9600 minims.

Beside these denominations, they still use in England the *Quarter* of 8 bushels = 2.908 hectoliters, and the *Chaldron* of 36 bushels or 12 sacks = 13.085 hectoliters.

Imperial into U. S. measures, and vice versâ.

1 Imperial Gallon = 1.2001 U. S. wine Gallon.
1 Imperial Bushel = 1.0315 U. S. Bushel.
1 U. S. wine Gall. = 0.83311 Imperial Gallon.
1 U. S. Bushel = 0.96945 Imperial Bushel.

NOTE.—Any number of *Imperial* gallons, multiplied by 1.2001, will give its equivalent in *U. S. wine* gallons; and any number of *U. S. wine* gallons, divided by 1.2001, will give its equivalent in *Imperial* gallons.

Likewise, Imperial bushels × 1.0315 give U. S. bushels; and U. S. bushels, divided by 1.0315, give Imp. bushels.

TABLES M, M′.—*British Imp. meas. of* CAPACITY *reduced into metric ones, and reciprocally.*

M.

N	Sacks in Hectoliters.	Imp. Bush. in Liters.	Imp. Gall. in Liters.	Imp. Quarts in Liters.	Imp. Pints in Liters.
1	1.09	36.35	4.544	1.14	0.57
2	2.18	72.70	9.087	2.27	1.14
3	3.27	109.05	13.631	3.41	1.70
4	4.36	145.40	18.175	4.54	2.27
5	5.45	181.75	22.719	5.68	2.84
6	6.54	218.10	27.262	6.82	3.40
7	7.63	254.45	31.806	7.95	3.97
8	8.72	290.80	36.350	9.09	4.54
9	9.81	327.15	40.894	10.22	5.11
10	10.905	363.50	45.437	11.36	5.68
Price per met.meas.	Price per sack.	Price per Imp. bushel.	Price per Imp. gallon.	Price per Imp. quart.	Price per Imp. pint.

M′.

N	Hectoliters in Sacks.	Hectoliters in Bushels.	Hectoliters in Gallons.	Liters in Quarts.	Liters in Pints.
1	0.917	2.751	22.008	0.88	1.76
2	1.834	5.502	44.017	1.76	3.52
3	2.751	8.253	66.025	2.64	5.28
4	3.668	11.004	88.033	3.52	7.04
5	4.585	13.755	110.042	4.40	8.80
6	5.502	16.506	132.050	5.28	10.56
7	6.419	19.257	154.058	6.16	12.32
8	7.336	22.008	176.066	7.04	14.09
9	8.253	24.759	198.075	7.92	15.85
10	9.1701	27.5104	220.083	8.8033	17.61
Price per Imp.meas.	Price per hectoliter.	Price per hectoliter.	Price per hectoliter.	Price per liter.	Price per liter.

REDUCTION OF CURRENCIES.

French and U. S. Money.—Equation.

One franc of standard gold weighs 0.3225806 grams; and one dollar of standard gold weighs 25.8 Troy grains, or $25.8 \times 0.64799 = 1.671813$ grams. Now, the standard being the same for the French and the U. S. gold coins, we have

$$1 \text{ franc} = \frac{3225806}{16718130} = \$0.192953;$$

$$\text{or, } 1 \text{ dollar} = \frac{16718130}{3225806} = \text{fr. } 5.182589.$$

English with French and U. S. Money.—Equations.

The pound sterling is represented by 123.274 Troy grains, or 7.98803 grams of gold at $\frac{11}{12}$ fine. From its contents of pure gold, the English pound would be intrinsically worth 25.22 francs, or \$4.866. But some light disadvantages in the conditions of the British coinage reduce this value to about fr. 25.20, or \$4.863.

Hence, 1 franc = £0.03968;
and 1 dollar = £0.2056.

Comparative Table.

	Weight.	Fineness.	Variation.	Intrinsic Value.
	grams.		thousandths.	
fr. 1	0.32258	$\frac{9}{10}$	2	\$0.1930, or £0.03968
\$1	1.67181	$\frac{9}{10}$	2	fr. 5.1826, or £0.2056
£1	7.9880	$\frac{11}{12}$	$2\frac{2}{48}$	fr. 25.20, or \$4.863.

TABLE N. — FRENCH MONEY *reduced into United States and English money, according to the gold standard and intrinsic value.*

1 Franc = 100 centimes.*

Francs.	Dollars.	Pounds ster.	Shillings.	Pence.
1	= 0.19 30	= 0.039 68	= 0.7936	= 9.523
2	= 0.38 59	= 0.079 36	= 1.587	= 19.05
3	= 0.57 89	= 0.119 04	= 2.381	= 28.57
4	= 0.77 18	= 0.158 72	= 3.174	= 38.09
5	= 0.96 48	= 0.198 40	= 3.968	= 47.62
6	= 1.15 77	= 0.238 08	= 4.762	= 57.14
7	= 1.35 07	= 0.277 76	= 5.555	= 66.66
8	= 1.54 36	= 0.317 44	= 6.349	= 76.19
9	= 1.73 66	= 0.357 12	= 7.142	= 85.71

TABLE O. — UNITED STATES MONEY *reduced into French and English money, as for Table N.*

1 Dollar = 100 cents.*

Dollars.	Francs.	Pounds ster.	Shillings.	Pence.
1 =	5.1826	= 0.2056	= 4.11	= 49
2 =	10.365	= 0.4112	= 8.22	= 99
3 =	15.548	= 0.6168	= 12.34	= 1 48
4 =	20.730	= 0.8222	= 16.45	= 1 97
5 =	25.913	= 1.0280	= 20.56	= 2 47
6 =	31.096	= 1.2336	= 24.67	= 2 96
7 =	36.278	= 1.4392	= 28.78	= 3 45
8 =	41.461	= 1.6448	= 32.90	= 3 95
9 =	46.643	= 1.8504	= 37.01	= 4 44

* *Centimes* and *Cents* have for their equivalents the same figures as *Francs* and *Dollars;* only the decimal point must be carried two places toward the left.

TABLE P.—ENGLISH MONEY *reduced into U. S. and French money, as for Table N.*

1 pound = 20 shilling = 240 pence.

Pounds sterling.	Dollars.	Francs.	Shillings.	Dollars.	Francs.	Pence.	Cents.	Centimes.
1 =	4.863 =	25.20	1 =	0.243 =	1.26	1 =	2.03 =	10.5
2 =	9.726 =	50.40	2 =	0.486 =	2.52	2 =	4.05 =	21
3 =	14.589 =	75.60	3 =	0.729 =	3.78	3 =	6.08 =	31
4 =	19.452 =	100.80	4 =	0.973 =	5.04	4 =	8.10 =	42
5 =	24.315 =	126.00	5 =	1.216 =	6.30	5 =	10.13 =	52
6 =	29.178 =	151.20	6 =	1.459 =	7.56	6 =	12.16 =	63
7 =	34.041 =	176.40	7 =	1.702 =	8.82	7 =	14.18 =	73
8 =	38.904 =	201.60	8 =	1.945 =	10.08	8 =	16.21 =	84
9 =	43.767 =	226.80	9 =	2.188 =	11.34	9 =	18.23 =	94
10 =	48.630 =	252.00	10 =	2.431 =	12.60	10 =	20.26 =	Francs.
11 =	53.493 =	277.20	11 =	2.675 =	13.86	11 =	22.29 =	1.16
12 =	58.356 =	302.40	12 =	2.918 =	15.12	12 =	24.32 =	1.26
13 =	63.219 =	327.60	13 =	3.161 =	16.38	13 =	26.34 =	1.37
14 =	68.082 =	352.80	14 =	3.404 =	17.64	14 =	28.36 =	1.47
15 =	72.945 =	378.00	15 =	3.647 =	18.90	15 =	30.39 =	1.575

TABLE Q.—*Showing the equivalents of assay carats in millièmes, and the real value in Francs, Dollars and Pounds sterling of one kilog. of gold at these different degrees of fineness.* See page 36.

Carats.	Millièmes or Thousandths.	Real Value of One Kilog. of Gold		
		in Francs.	in Dollars.	in Ster. Pounds.
1	41.67	fr.143.52	$27.692	£5.695
2	83	287.04	55.38	11.390
3	125	430.56	83.08	17.084
4	167	574.07	110.77	22.779
5	208	717.59	138.46	28.474
6	250	861.11	166.15	34.169
7	292	fr.1004.63	$193.85	£39.864
8	333	1148.15	221.54	45.558
9	375	1291.67	249.23	51.253
10	416.7	1435.19	276.92	56.948
11	458	1578.70	304.62	62.643
12	500	1722.22	332.31	68.338
13	542	fr.1865.74	$360.00	£74.032
14	583	2009.26	387.69	79.727
15	625	2152.78	415.38	85.422
16	667	2296.30	443.08	91.116
17	708	2439.81	470.77	96.812
18	750	2583.33	498.46	102.507
19	792	fr.2726.85	$526.15	£108.202
20	833	2870.37	553.85	113.896
21	875	3013.89	581.54	119.591
22	916.7	3157.41	609.23	125.286
23	958	3300.93	636.92	130.981
24	1000	3444.444	664.614	136.676

Use of Table Q.—*Ex.* To find in dollars and cents the real value of 175 grams of gold at 22 carats?

For 1 kilog., or 1000 grams of such gold, this table gives $609.23. Hence we have the proportion

$$1000 : 609.23 : : 175 : x = \$106.615.$$

For 100, 10, 1 grams of gold remove the decimal point of the tables respectively 1, 2, 3 places toward the left.

TABLE R.—*Millièmes in carats and real value of* 1 *kilog. of Gold for every Millième of fine metal.*

Millièmes or Thous'dths.	Assay Carats.	Real Value of One Kilogram of Gold		
		in Francs.	in Dollars.	in £ sterling.
100	2.4	fr. 344.44	$66.46	£13.668
200	4.8	688.89	132.92	27.335
300	7.2	1033.33	199.38	41.003
400	9.6	1377.78	265.85	54.670
500	12	1722.22	332.31	68.338
600	14.4	2066.67	398.77	82.006
700	16.8	2411.11	465.23	95.673
800	19.2	2755.56	531.69	109.341
900	21.6	3100.00	598.15	123.008
1000	24	3444.444	664.614	136.676

Use of Table R.—*Ex.* To find in francs and centimes the real value of 214.8 grams of gold at 840 millièmes fine:

For gold at 800 millièmes, this table gives 2755.56 per kilog.
" 40 " " " 137.78 "
Hence gold at 840 " is worth 2893.34 fr. "

or 2.89334 fr. per gram. Therefore, the real value of 214.8 grams of such gold = $2.89334 \times 214.8 = 621.49$ fr.

Notes.—1. In the two preceding tables the value of the metal alloyed with gold is altogether neglected.

2. These tables may be used to reckon the value of silver at any degree of fineness, provided the price of silver compared to that of gold be accurately known.

Ex. To find in French money the real value of 2.45 kilog. of silver at 750 millièmes, its value being to that of gold as 1 is to 15, by weight.

We first consider silver as if it were gold, and say:

At 700 millièmes fine, gold is worth fr.2411.11 per kg.
" 50 " " " 172.22 "

Hence, at 750 millièmes fine gold is worth fr.2583.33 "

Therefore, 2.45 kilograms of such gold are worth

$$2583.33 \times 2.45 = \text{fr. } 6318.17.$$

Now, the value of an equal weight of silver being 15 times less—

$$= \frac{6318.17}{15} = \text{fr. } 421.21.$$

EQUATION OF MARKET PRICES.

For the convenience of merchants, statisticians, travelers, etc., we have prepared a table which gives in U. S. money and per U. S. measure the prices corresponding to those expressed in francs and centimes, and referring to metric measures, such as are the market prices of France, Belgium, Italy, and of all countries where French money and metric measures are used.

Reciprocally, this table shows in French money and per metric measure the prices corresponding to those of the U. S. markets, which we suppose to be expressed in U. S. money and to refer to U. S. measures.

Thus, we see (a') that to buy or sell goods at 1 franc per meter is the same as to buy or sell them at $17\frac{64}{100}$ cents per yard; and (a) that goods which cost $1.00 per yard cost 5 fr. 67 centimes per meter.

Likewise, when 1 kilogram of beef sells for 1 fr. in Paris, 1 pound would sell for only $8\frac{3}{4}$ cents.

TABLE S.—*Prices in money and for measures of the U. S. reduced into prices in French money and for metric measures, and reciprocally.**

Lengths—a.

	By approximation.	More exactly.
$1 per mile is fr.	3.22 per kilom.,	or fr. 3.2203
$1 per yard is fr.	5.67 per meter,	or fr. 5.6677
$1 per foot is fr.	17.00 per meter,	or fr. 17.0032
$1 per inch is fr.	2.04 per centim.,	or fr. 2.0404

a′.

1 fr. per kilom.	is $0.31 per mile,	or $0.31053
1 fr. per meter	is $0.176 per yard,	or $0.17644
	$0.059 per foot,	or $0.05881
1 fr. per centim.	is $0.49 per inch,	or $0.49010

Surfaces—b.

$1 per acre	is fr. 12.81 per Hectare,	or fr. 12.8064
$1 per sq. yard	is fr. 6.20 per sq. meter,	or fr. 6.19815
$1 per sq. foot	is fr. 55.78 per sq. meter,	or fr. 55.7837
$1 per sq. inch	is fr. 0.80 per sq. centim.	or fr. 0.8033

b′.

1 fr. per Hectare	is $0.084 per acre,	or $0.084033
1 fr. per sq. meter	is $0.161 per sq. yard,	or $0.161335
	$0.018 per sq. foot,	or $0.017926

* This table is calculated on the basis of gold according to the present (1869) French and U. S. coinages.

TABLE S.—*Continuation.*

Cubes—c.

$1 per cub. yard is fr. 6.78 per cub. meter, or fr. 6.7785
$1 per cub. foot is fr. 183.02 per cub. meter,
$1 per cord is fr. 1.43 per stere, or fr. 1.4298
$1 per cub. inch is fr. 0.32 per cub. centim. or fr. 0.3163

c'.

1 fr. per cub. meter is $0.17¾ per cub. yard, or $0.17753
1 fr. per cub. decim. is $5.46 per cub. foot, or $5.4639
1 fr. per cub. centim. is $3.16 per cub. inch, or $3.1619
1 fr. per stere is $0.70 per cord, or $0.69937

Capacities—d.

$1 per bushel is fr. 14.71 per Hectoliter, or fr. 14.7068
$1 per peck is fr. 5.88 per Dekaliter, or fr. 5.8828
$1 per qt. (dry) is fr. 4.71 per liter, or fr. 4.7063
$1 per wine gall. is fr. 1.37 per liter, or fr. 1.3691
$1 per wine qt. is fr. 5.48 per liter, or fr. 5.4763
$1 per wine pt. is fr. 10.95 per liter, or fr. 10.9527

d'.

1 fr. per Hectoliter is $0.068 per bushel, or $0.0680
1 fr. per Dekaliter is $0.17 per peck, or $0.1700
1 fr. per liter is
$0.21 per dry quart, or $0.2128
$0.73 per wine gall., or $0.7304
$0.18 per wine quart, or $0.1826
$0.09 per wine pint, or $0.0913

Weights—e.

$1 per C. H. ton is fr. 5.10 per met. ton, or fr. 5.1007
$1 per 2000 lb. ton is fr. 5.71 per met. ton, or fr. 5.7128
$1 per pound av. is fr. 11.43 per kilogram, or fr. 11.4256
$1 per ounce av. is fr. 0.18 per gram, or fr. 0.1828
$1 per lb. Troy is fr. 13.89 per kilogram, or fr. 13.8853
$1 per ounce Troy is fr. 16.66 per hectog. or fr. 16.6624

TABLE S.—*Continuation* (e').

1 fr. per metric ton is	\$ 0.196 per ton of 2240 lbs.,	or \$ 0.19605
	\$ 0.175 per ton of 2000 lbs.,	or \$ 0.17504
1 fr. per kilogram is	\$ 0.08¾ per pound av.,	or \$ 0.08752
1 fr. per gram is	\$ 5.47 per ounce av.,	or \$ 5.4701
	\$72.02 per pound Troy,	or \$72.0180
	\$ 6.00 per ounce Troy,	or \$ 6.0015
	\$ 0.75 per ap. dram,	or \$ 0.7502
	\$ 0.25 per ap. scruple,	or \$ 0.2500
	\$ 0.30 per pennywt.,	or \$ 0.30007
1 fr. per centigram is	\$ 1.25 per Troy grain,	or \$ 1.2503

Remark. When prices are stated in such numbers, as one franc forty-five centimes per meter, twelve cents per yard, seventy-five dollars per acre, Table S is made available by means of a simple multiplication, according to the following

RULE.—*Whatever the price per yard, per meter, etc. may be, multiply it by the number corresponding in this table to* \$1 *per yard,* 1 *franc per meter, etc.; the result will be the required price per meter, per yard, etc.*

EXAMPLES.

1. A piece of cloth costs fr. 17.35 per meter; what does it cost per yard in dollars and cents?

Solution. The price per yard corresponding to one franc per meter is found (a') to be \$0.1764. Therefore, $17.35 \times 0.1764 = \$3.06$.

2. A vineyard in France was sold at fr. 15486 per hectare; what did it cost per acre in U. S. money?

Solution. Corresponding to one franc per hectare the table gives (b') \$0.084 per acre; therefore, 15486× 0.084033 gives the answer \$1301.33.

3. Wood has been bought at \$4.75 per cord; what is it per stere in francs and centimes?

Ans. 4.75×1.43 (c) = fr. 6.77.

4. Wheat sells in Marseilles at fr. 21.75 per hectoliter; what would the bushel be worth in U. S. money?

Ans. 21.75 × 0.068 (d') = \$1.479.

5. Refined petroleum sells in New York at 23 cents gold per gallon; what is it per liter, and per hectoliter, in French money?

Ans. 0.23 × 1.3691 (d) = fr. 0.3149 = 31½ centimes per liter, or fr. 31.49 per hectoliter.

6. Cotton sells in New Orleans at 17½ cents per lb.; what is it worth per kilogram in French money?

Ans. 0.175 × 11.4256 (e) = fr. 2.00 per kg.

TABLE T.—*Miscellanea.*

1 pound av. per foot	is	1.4882 kilograms per meter.
1 kilogram per meter	is	0.6720 lb. av. per foot.
1 pound per cubic foot	is	16.0184 kilog. per cub. meter.
1 kilog. per cub. decim.	is	62.4280 lbs. av. per cub. foot.
1 pound per U.S. bushel	is	1.2872 kg. per hectoliter.
1 kilog. per hectoliter	is	0.7769 av. lb. per bushel.
1 lb. per U. S. liq. gall.	is	1.1956 hectograms per liter.
1 kilogram per liter	is	8.3455 lbs. per liquid gallon.
1 pound per acre	is	1.1208 kilog. per hectare.
1 kilog. per hectare	is	0.8922 lb. per acre.
1 bushel per acre	is	8.7078 dekalit. per hectare.
1 hectoliter per hectare	is	1.1484 bushels per acre.

FOREIGN WEIGHTS AND MEASURES.

THE metric weights and measures have already been adopted to the exclusion of all others by France, Belgium, Holland, Italy, Spain, Portugal and Greece. Prussia, with all the States of the North German Confederation, will be added to this list from January 1, 1872. In 1864 the metric system was legalized in Great Britain; and, two years later, in the United States. Its use has also been either generally or partially authorized in Austria, Denmark, Sweden and Switzerland, and in almost all the States of Central and South America. Its immediate adoption for the British possessions of the East Indies is now urged by the Colonial Government as the only remedy against the uncertainty and confusion of weights and measures in that country. If, in less civilized nations, steps have not as yet been taken toward the same end, the rapid increase of communications gives reason to hope that the day is not far distant when the trade of the world will be based upon the "uniform standard."

Among the weights and measures which have already been, or are to be, superseded by the improved system, the more important will be found in the following

TABLE U.—*Showing the English and Metric equivalents of the better-known weights and measures.*

AUSTRIA. *Lengths:* 1 meile = 4000 klafter = 24,000 fuss, or feet,	4.712 miles.	7586 meters.
Land: 1 jock, or juchart = 1600 sq. klafter, ...	1.422 acres.	57.55 ares.
Dry capacity: 1 metze = 4 viertel = 16 muhlmassel, ...	1.745 bush.	61.50 liters.
Liquid capacity: 1 eimer = 4 viertel = 40 mass, ...	14.942 gall.	56.564 "
Weight: 1 pfund = 16 ounces = 128 drachms, ...	1.2347 lb.	560.012 grams.
DENMARK. The pound = 500 grams; the Rhenish foot, is .	1.03 feet.	31.385 cm.
FRANCE. The *toise* of 6 pieds, or 72 pouces, was, ...	6.394 feet.	1.949 meters.
The *livre* = 2 marcs = 16 onces = 9216 grains, ...	1.077 lb.	489.5 grams.

PORTUGAL. The milha is 1.28 miles; the vara,	3.585 feet.	1.096meters.
Land: 1 geira = 4840 sq. varas,	1.429 acres.	57.83 ares.
Dry cap.: at Lisbon, 1 fanga = 4 alqueires,	1.535 bush.	54.06 liters.
Liq. cap.: at Lisbon, 1 almude = 2 cantaros = 12 canadas,	4.370 gall.	16.54 "
" at Oporto, 1 almude = 2 " 12 "	6.731 gall.	25.48 "
Weights: 1 quintal = 4 arrobas = 128 arratels of 16 oz. each,	129.5 lb.	58.75 kilog.
PRUSSIA. *Length:* 1 post meile = 2000 ruthen,	4.58 miles.	7532.4 meters.
1 fuss, or Rhenish foot = 12 zoll = 144 linien,	1.03 feet.	31.385 cm.
Land: 1 morgen = 180 sq. perches (3054 sq. yds.),	0.631 acres.	25.53 ares.
Dry cap.: 1 scheffel = 4 viertel = 16 metzen,	1.559 bush.	54.95 liters.
Liq. cap.: 1 eimer = 2 ankers = 60 quartiers,	18.146 gall.	68.69 "
Weights: 1 pfund, or pound of Cologne = 16 unzen,	1.031 lb.	467.7 grams.
RUSSIA. *Length:* 1 verst = 500 sashins = 1500 arshins,	3500 feet.	1066.8 meters.
Land: 1 deciatine = 2400 sq. sashins,	2.70 acres.	109.25 ares.
Dry cap.: 1 osmen = 2 payaks = 16 tchetverkas,	2.977 bush.	104.91 liters.
Liq. cap.: 1 anker = 3 vedros,	9.748 gall.	36.90 "
Weights: 1 funt = 12 lanas = 32 loths = 9216 doly,	0.9026 lb.	409.3 grams.
1200 funts = 10 berkovitz = 1 packen,	1082.8 lb.	491.16 kg.
SPAIN. The following are the old standards of Castile:		
Lengths: 1 vara = 3 pies.	2.782 feet.	83.59 cm.
Land: 1 fanega superficial = 9216 sq. varas.	1.5912acres.	64.396 ares.
Dry cap.: 1 fanega = 12 almudes = 48 quartillos,	1.575 bush.	55.50 liters.
Liq. cap.: 1 arroba = 8 azumbres = 32 quartillos,	4.218 gall.	16.133 "
Weights: 1 libra = 16 onzas = 9216 granos,	1.014 lb.	460.13 grams.

The old weights and measures of Spain and Portugal are still used in some of their former colonies of America. Those of Turkey, Egypt, Hindostan, China, etc., are in such number and variety that even a very incomplete list of them would extend beyond the compass of this manual.

TABLE V.—*Showing the weight, fineness and intrinsic value of the most important Foreign Coins in present use.*

Equation (assumed): 1 gram of gold = 15.5 grams of silver.

EUROPE AND NORTHERN AFRICA.

G = gold.
S = silver.

	Weight.	Fineness.	Intrinsic Value.	
	grams.	thous'dths.	francs.	dollars.
G. 100 Francs coin (50, 20, 10 fr. in proportion), .	32.258	900	100	19.295
G. Centen=10 Escudos=100 Reales of Spain,* 1864,	8.387	895	25.99	5.018
G. Ducat of Austria, Baden, Bavaria, Netherlands,	3.490	980	11.77	2.155
S. Florin of Austria = 70 kreutzers, 1857, . . .	12.345	900	2.47	0.476
S. Florin or Guild of Netherlands=100 cents, 1849,	10.000	945	2.10	0.405
S. Gulden, or Florin of 60 kreutzers of Baden, Bavaria and Wurtemberg, ...	10.606	900	2.12	0.410
G. 10 Milreis of Portugal, since 1864, ...	17.783	917	56.14	10.835
G. 100 Piastres of Turkey, ...	7.150	915	22.53	4.350
G. 100 Piastres, coin of Egypt, ...	8.500	874	25.59	4.938
G. 100 Piastres in gold of Tunis, average, . . .	19.454	900	60.31	11.640
G. 10 Rigsdaler, or Frederick of Denmark, . .	6.600	895	20.45	3.946
G. Rouble of Russia = 100 kopeck, in gold coin, .	1.313	916	4.14	0.799
S. Rouble, in silver coin, ...	20.511	865	3.96	0.764

* France, Belgium, Italy, Switzerland, Greece and Spain have adopted the same coinage, so that the coins of any one of these countries are now current in the others.

G. Sovereign of England	new,	7.988	916.6	25.20	4.863
	average,	7.980	916	25.14	4.850
S. Thaler = 100 kreutzers,	German,	18.517	900	3.71	0.716
G. Krone, for 10 thalers,	Zolleverein, 1857.	11.111	900	34.44	6.646

AMERICA.

G. 10 Dollars, gold coin of the U. S.,	16.718	900	51.83	10.000
S. 10 Dollars, in silver coin, 1837–1853,	267.290	900	53.46	10.317
S. 10 Dollars, in ½ and ¼ dollar coins, since 1853,	248.828	900	49.76	9.603
G. 10 Milreis of Brazil,	8.963	916	28.22	5.445
S. Piastre of Mexico, Peru, Bolivia, Argentine Republic and Guatemala,	27.000	900	5.40	1.042
S. Piastre of Chili, Ecuador, New Grenada,	25.000	900	5.00	0.965
S. Piastre of Uraguay,	27.000	875	5.25	1.003
S. Piastre of Venezuela,	25.000	800	4.44	0.856
G. Pistole, Bolivia, Chili, Ecuador,	6.750	875	20.34	3.925
G. Quadruple, Guatemala, Mexico, and Peru,	27.000	875	81.37	15.704

ASIA.—The mohur of 4 Pagodas, gold coin of the British East Indies, is worth fr. 36.83 = $7.10; the roupee of silver = 16 annas, is worth 2.38 francs. The taël is a money of account, worth, in China, fr. 8.24; in Japan, fr. 7.62.

The Units, Pronunciation and Abbreviations of the names of the Metric Weights and Measures used.

The units more commonly used are printed in italics, or in capitals.

UNITS USED.	PRONUNCIATION.*	SYMBOLS AND ABBREVIATIONS.	
Long meas.			
Millimeter,	mĭl'li-mē-ter,	mm.	millim.
Centimeter,	cĕn'ti-mē-ter,	cm.	centim.
Decimeter,	dĕc'i-mē-ter,	dm.	decim.
METER,	mē'ter,	m.	
Dekameter,	dĕk'a-mē-ter,	dkm.	dekam.
Hectometer,	ĕk'to-mē-ter,	hm.	hectom.
Kilometer,	kĭl'o-mē-ter,	km.	kilom.
Land meas.			
Centiare,	cĕn'ti-ăr,	ca.	
ARE,	ăr (*as in* far),	a.	
Hectare,	ĕk'tăr,	ha.	
Solid meas.			
Decistere,	dĕc'i-stair,	dst.	decist.
STERE,	stair,	st.	
Dekastere,	dĕk'a-stair,	dkst.	dekast.
Capacity.			
Milliliter,	mĭl'li-lî-ter,	ml.	millil.
Centiliter,	cĕn'ti-lî-ter,	cl.	centil.
Deciliter,	dĕc'i-lî-ter,	dl.	decil.
LITER,	lîter (î *like* ee),	l.	
Dekaliter,	dĕk'a-lî-ter,	dkl.	dekal.
Hectoliter,	ĕk'to-lî-ter,	hl.	hectol.
Kiloliter,	kĭl'o-lî-ter,	kl.	kilol.
Weights.			
Milligram,	mĭl'li-grăm,	mg.	millig.
Centigram,	cĕn'ti-grăm,	cg.	centig.
Decigram,	dĕc'i-grăm,	dg.	decig.
GRAM,	grăm,	g.	
Dekagram,	dĕk'a-grăm,	dkg.	dekag.
Hectogram,	ĕk'to-grăm,	hg.	hectog.
Kilogram,	kĭl'o-grăm,	kg.	kilog.

* ē *is long,* ă, ĕ, ĭ, *are short;* a, e, i, *obscure;* î, *like* ee.